

Surveys
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REPORT OF
FOREST INSECT DETECTION SURVEYS
IN OREGON AND WASHINGTON
Season of 1951

Compiled by
Oregon State Board of Forestry

and

Bureau of Entomology and Plant Quarantine
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Forest Insect Laboratory
445 U. S. Court House
Portland 5, Oregon
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TABLE OF CONTENTS

	PAGE
INTRODUCTION.	1
PART I - SPRUCE BUDWORM PROBLEM	2
General Statement.	2
Graph 1 - Progress of the Epidemic 1944-1951.	3
Table 1 - Acreage Summary by Infestation Intensity, 1951.	5
Table 2 - Acreage Summary by Ownerships, 1951	7
1951 Spruce Budworm Situation by Areas and Control Units	9
Western Oregon Area	10
1. Willamette Unit.	10
Eastern Oregon Cascades Area.	11
2. Mt. Hood Unit.	11
3. Warm Springs Unit.	12
4. Deschutes Unit	12
Blue Mountains - Oregon Area.	12
5. Ochoco Unit.	14
6. Waterman Unit.	14
7. Malheur Unit	14
8. Susanville Unit.	14
9. Dale Unit.	14
10. Powder River Unit.	15
11. La Grande Unit	15
12. Starkey Unit	15
13. Eagle Creek Unit	15
14. Minam Unit	15
15. Joseph Unit.	16
16. Snake Unit	16
17. Chesnimnus Unit.	16
18. Day Ridge Unit	16
19. Elgin Unit	17
20. Wenaha Unit.	17
Blue Mountains-Washington Area.	17
21. Saddle Mountain Unit	18
22. Touchet Unit	18
23. Anatone Unit	18
Eastern Washington Cascades Area.	19
24. Wenatchee Unit	19
Discussion and Recommendations.	20

	PAGE
PART II - OTHER MAJOR FOREST INSECT PROBLEMS	22
Mountain Pine Beetle	22
Western Pine Beetle.	23
Douglas Fir Beetle	23
Fir Engraver Beetles	24
Hemlock Looper	24
PART III - APPENDIX	25
Acknowledgments.	25
List of Reports and Publications	26
Table 3 - Aerial Survey Coverage, 1951	
Table 4 - Participation on 1950 and 1951 Ground Survey	
Table 5 - Ground Survey Check Plots, 1949-1951	
Table 6 - Ground Survey Coverage in Western Oregon, 1951	
Table 7 - Ground Survey Coverage in Eastern Oregon, 1951	
Table 8 - Ground Survey Coverage in Western Washington, 1951	
Table 9 - Ground Survey Coverage in Eastern Washington, 1951	
Map 1 - Distribution of the Spruce Budworm, 1947-1951	
Map 2 - Spruce Budworm in Oregon and Washington, 1951	

REPORT OF FOREST INSECT DETECTION SURVEYS IN OREGON AND WASHINGTON

SEASON OF 1951

INTRODUCTION

A total of 2,128,000 acres has been sprayed during the years 1949-1951 to control the spruce budworm in Oregon and Washington. The over-all extent of the outbreak has been reduced from a peak of 2,276,000 acres in 1949 to 1,651,000 acres in 1951 and the area of heavy infestation has been reduced from 887,000 acres in 1949 to 82,000 acres in 1951. The killing of timber has been confined to less than 10,000 acres. The outbreak has been kept from spreading extensively in the Douglas fir region of western Oregon through a series of aerial spraying projects. The total cost of the control work to date has been about \$2,300,000.

The budworm control program has reached what should be its concluding phases, provided natural control factors take full effect within the next two or three years. The problem now is to protect the gains that have been made and to extend control to those stands that are currently heavily defoliated. The purpose of the present report is to provide the basic data for developing the control program for 1952.

The results of the 1951 forest insect detection survey program, the fifth in a series of region-wide cooperative surveys in Oregon and Washington, are presented in the report which follows. Because of its importance the 1951 spruce budworm situation, which is summarized in Graph I and in Tables 1 and 2, is considered in detail in Part I. Part II contains a brief discussion of other major forest pests causing losses in 1951. Part III contains: (1), Acknowledgments of the generous support given to the program by private and public agencies and individuals; (2), tables 3 to 9 which present the 1951 field survey data; (3), a list of references to reports and publications on the budworm and the surveys; and (4), maps showing the distribution of the spruce budworm from 1947 to 1951 and the status of the budworm in 1951.

PART I - SPRUCE BUDWORM PROBLEM

General Statement

The history of the spruce budworm outbreaks, the findings of the past four forest insect detection survey programs and the results of the several control projects undertaken to suppress the budworm epidemics in Oregon and Washington have been presented in a number of reports and publications. A list of these references is given in the Appendix. The present report will be confined to the findings of the 1951 survey program.

A fifth comprehensive and fully cooperative forest insect detection survey, covering some 49,000,000 acres of forested lands in Oregon and Washington, exclusive of the three northeastern counties in Washington, was begun on June 19, 1951 while the spruce budworm control project of 1951 was still in progress. Aerial and ground survey techniques, similar to those employed in 1949 and 1950 were followed and, once again, public and private agencies and individuals generously participated in the program.

In general, the 1951 budworm survey was hampered by the serious forest fire situation in both states which prevented many individuals, associated with the ground survey in former years, from participating in the program and which also slowed down the progress of the aerial phase of the program. In spite of this handicap, the following accomplishments can be reported for 1951: (1), the aerial survey was completed in 202.3 hours of flying time (Table 3); (2), some 399 man days were expended by the 123 individuals participating in the budworm ground survey (Table 4); and (3), in lightly infested areas 3,474 sample plots were examined for the presence or absence of the budworm, with this insect being found on only 161 (4.6 percent) of the plots (Table 5).

The course of the present spruce budworm epidemic in Oregon and Washington from 1944 through 1951 is depicted in Graph 1 and on Map 1. The over-all status of the 1951 epidemic is presented in Table 1 by areas and logical control units according to the intensity of the infestation. Table 2 gives the 1951 infestation data by forest ownerships. A record of the individuals having a part in the 1951 ground survey and their findings is given in Tables 6-9. Map 2 shows the extent of the spruce budworm epidemic in 1951 and the areas already brought under control through the aerial spraying projects of 1949-1951.

Graph I
PROGRESS OF SPRUCE BUDWORM EPIDEMIC
IN OREGON AND WASHINGTON

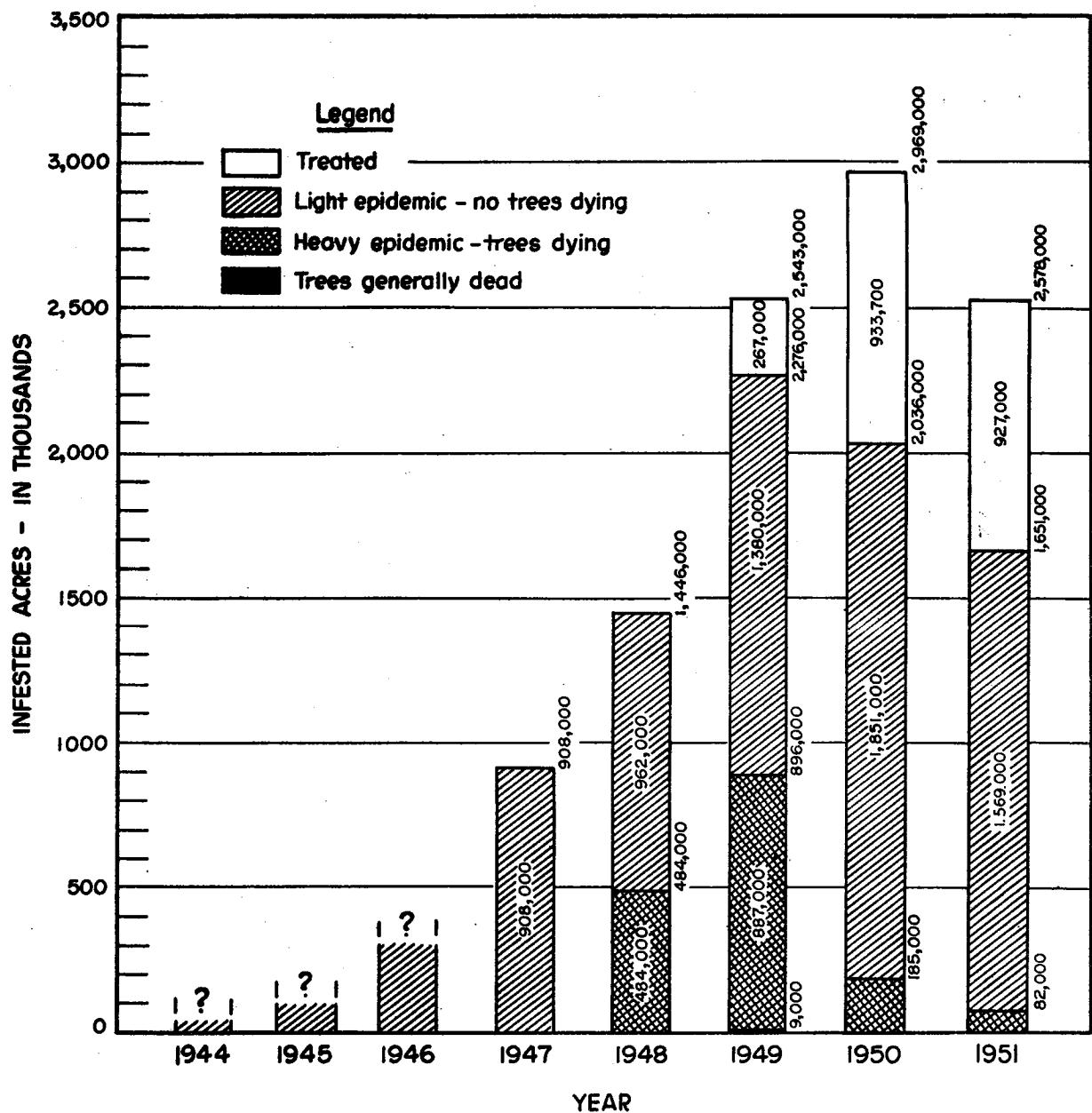


TABLE 1. SUMMARY OF 1951 SPRUCE BUDWORM EPIDEMIC INFESTATIONS BY INTENSITIES 1/

AREA AND UNIT	INTENSITY OF INFESTATION						Total Acres	% Total
	Light Acres	Light %	Moderate Acres	Moderate %	Heavy Acres	Heavy %		
WESTERN OREGON								
(1) Willamette	26,240	46.1	30,720	53.9			56,960	100
EASTERN OREGON CASCADES								
(2) Mt. Hood	12,000	53.2	8,960	39.7	1,600	7.1	22,560	100
(3) Warm Springs	29,440	86.0	4,800	14.0			34,240	100
(4) Deschutes	20,640	100.0					20,640	100
Total	62,080	80.2	13,760	17.8	1,600	2.0	77,440	100
BLUE MOUNTAINS-OREGON								
(5) Ochoco	65,120	75.9	20,640	24.1			85,760	100
(6) Waterman			18,000	43.9	23,000	56.1	41,000	100
(7) Malheur	117,440	82.4	24,960	17.6			142,400	100
(8) Susanville	18,880	100.0					18,880	100
(9) Dale	23,520	100.0					23,520	100
(10) Powder River	6,080	100.0					6,080	100
(11) La Grande	41,120	100.0					41,120	100
(12) Starkey	156,960	73.8	55,680	26.2			212,640	100
(13) Eagle Creek	24,960	100.0					24,960	100
(14) Minam	6,400	9.0	38,880	54.9	25,600	36.1	70,880	100
(15) Joseph	106,240	100.0					106,240	100
(16) Snake	133,120	72.7	49,920	27.3			183,040	100
(17) Chesnimnus	50,560	58.4	27,680	32.0	8,320	9.6	86,560	100
(18) Day Ridge	24,640	77.4	7,200	22.6			31,840	100
(19) Elgin	82,720	38.4	132,800	61.6			215,520	100
(20) Wenaha	36,160	92.6	2,880	7.4			39,040	100
Total	893,920	67.2	378,640	28.5	56,920	4.3	1,329,480	100
TOTAL FOR OREGON	982,240	67.1	423,120	28.9	58,520	4.0	1,463,880	100
BLUE MOUNTAINS-WASHINGTON								
(21) Saddle Mountain	31,040	59.3	21,280	40.7			52,320	100
(22) Touchet	10,720	30.3	24,640	69.7			35,360	100
(23) Anatone	11,840	12.4	60,160	63.2	23,200	24.4	95,200	100
Total	53,600	29.3	106,080	58.0	23,200	12.7	182,880	100
EASTERN WASHINGTON CASCADES								
(24) Wenatchee	3,840	100.0					3,840	100
TOTAL FOR WASHINGTON	57,440	30.8	106,080	56.8	23,200	12.4	186,720	100
GRAND TOTAL	1,039,680	63.0	529,200	32.1	81,720	4.9	1,650,600	100

1/ Does not include 926,729 acres sprayed in 1951

926,729
2,577,519

TABLE 2. SUMMARY OF 1951 SPRUCE BUDWORM EPIDEMIC INFESTATIONS BY OWNERSHIPS 1/

AREA AND UNIT	OWNERSHIP CLASSES					
	Forest Service	Indian Service	State, Priv. and Other	Total	Acres	%
WESTERN OREGON						
(1) Willamette	56,960	100.0			56,960	100
EASTERN OREGON CASCADES						
(2) Mt. Hood	22,080	97.9		480	2.1	22,560 100
(3) Warm Springs			34,240 100.0			34,240 100
(4) Deschutes	20,640	100.0				20,640 100
Total	42,720	55.2	34,240 44.2	480	0.6	77,440 100
BLUE MOUNTAINS-OREGON						
(5) Ochoco	59,680	69.6		26,080	30.4	85,760 100
(6) Waterman			41,000 100.0			41,000 100
(7) Malheur	88,160	61.9	54,240	38.1	142,400 100	
(8) Susanville	15,520	82.2	3,360	17.8	18,880 100	
(9) Dale	23,360	99.3	160	0.7	23,520 100	
(10) Powder River	4,800	78.9	1,280	21.1	6,080 100	
(11) La Grande	31,520	76.7	9,600	23.3	41,120 100	
(12) Starkey	130,620	61.4	19,360	9.1	62,660	29.5
(13) Eagle Creek	23,360	93.6	1,600	6.4	24,960 100	
(14) Minam	60,800	85.8	10,080	14.2	70,880 100	
(15) Joseph	89,920	84.7	16,320	15.3	106,240 100	
(16) Snake	176,000	96.2	7,040	3.8	183,040 100	
(17) Chesnimnus	83,520	96.5	3,040	3.5	86,560 100	
(18) Day Ridge	21,760	68.3	10,080	31.7	31,840 100	
(19) Elgin	141,120	65.5	74,400	34.5	215,520 100	
(20) Wenaha	34,560	88.5	4,480	11.5	39,040 100	
Total	984,700	74.1	19,360	1.4	325,420	24.5
TOTAL FOR OREGON	1,084,380	74.1	53,600	3.6	325,900	22.3
						1,463,880 100
BLUE MOUNTAINS-WASHINGTON						
(21) Saddle Mountain	44,800	85.6		7,520	14.4	52,320 100
(22) Touchet	30,560	86.4		4,800	13.6	35,360 100
(23) Anatone	69,120	72.6		26,080	27.4	95,200 100
Total	144,480	79.0		38,400	21.0	182,880 100
EASTERN WASHINGTON CASCADES						
(24) Wenatchee		3,840 100.0				3,840 100
TOTAL FOR WASHINGTON	148,320	79.4		38,400	20.6	186,720 100
GRAND TOTAL	1,232,700	74.7	53,600	3.2	364,300	22.1
						1,650,600 100

1/ Does not include 926,729 acres sprayed in 1951.

The acreage of epidemic infestation recorded during the 1951 survey by areas and by states is as follows:

Blue Mountains Area - Oregon	1,329,480 Acres
Blue Mountains Area - Washington	182,880 "
Eastern Oregon Cascades Area	77,440 "
Western Oregon Area	56,960 "
Eastern Washington Cascades Area	<u>3,840</u> "
Area Totals	1,650,600 Acres
Total for Oregon	1,463,880 Acres
Total for Washington	<u>186,720</u> Acres
State Totals	1,650,600 Acres

In addition to this acreage of readily recognizable epidemic infestation that can be detected from the air, there are extensive areas on which the budworm is present in small numbers in both Oregon and Washington. It may be significant that on the ground survey plots, outside the epidemic centers, the percentage of plots showing budworm decreased in 1951.

During the course of the budworm epidemic in Oregon and Washington, five degrees of epidemic infestation based upon the degree of defoliation have been recognized, as follows:

- Light - Defoliation light, barely visible from the air; no tree killing expected for at least two years.
- Moderate - Defoliation moderate; no tree-killing expected for at least one year.
- Heavy - Defoliation moderate to severe; some tree-killing in progress; general tree killing probable next year.
- Very Heavy - Defoliation severe; general tree killing in progress.
- Dead - Defoliation complete; trees predominantly dead on extensive areas.

It is encouraging to note that the infestation recorded during the 1951 survey was confined to the light, moderate and heavy categories. No new centers of very heavy infestation or dead timber were found in 1951.

1951 Spruce Budworm Situation by Areas and Control Units

The findings of the 1951 survey will be discussed by areas and the numbered control units shown in Tables 1 and 2 and on Map 2.

Western Oregon Area

The spruce budworm control strategy recommended by the Action Committee and approved by the public for the protection of the high value forests of western Oregon has been to treat all centers of epidemic infestation regardless of their intensity. The record of the development of budworm infestations and the control operations undertaken in this area is as follows:

<u>Year</u>	<u>Epidemic Acreage Recorded by the Surveys</u>	<u>Total Sprayed Acreage (Infested Acres Plus Buffer Zone)</u>
1948	86,200 acres	
1949	88,640 "	
1950	96,405 "	
1951	56,960 "	

MT Hood NF

*119,730 -6240 273,674
113,440 161,919
153,319 6,290
155,629*

Total Sprayed Acreage
(Infested Acres Plus Buffer Zone)

Three control units in western Oregon were treated during the 1951 control project: Willamette-Mckenzie unit 153,319 acres, Clackamas River Unit (Sisi Butte) 6,290 acres and Roseburg Unit 2,310 acres. Spruce budworm mortality resulting from these operations was satisfactory. The mortality on the Willamette-Mckenzie Unit ranged from 95.5 to 100 percent and averaged 99.1 percent. On the Roseburg Unit, mortality of 99.0 percent was recorded. Although no mortality checks were made in the Clackamas River Unit it is felt that equally satisfactory control was effected as a result of the spraying.

During the 1951 ground survey in western Oregon a total of 1,703 sample plots was carefully examined by survey personnel in 197 man days. The budworm was found to be present on 116 plots (6.8%) and absent on 1,587 plots (93.2%).

It is of considerable interest to note that the 1951 survey did not show any additional epidemic infestations in the vicinity of Roseburg, Eugene or Sisi Butte. This fact gives emphasis to the value and effectiveness of control operations undertaken in 1949, 1950 and 1951 in these units. The only epidemic infestation recorded in western Oregon in 1951 was on the McKenzie Bridge Ranger District of the Willamette National Forest.

1. Willamette Unit - The 1951 survey revealed a total of 56,960 acres of epidemic infestation in western Oregon, mostly in the South Fork McKenzie River drainage on the Willamette National Forest. This infestation was classified as 26,240 acres (46.1%) of light infestation and 30,720 acres (53.9%) of moderate infestation with the ownership 100 percent federal. An additional 16,040 acres of buffer zone should be added to this unit to control incipient infestations adjacent to the visible epidemic areas recorded during the survey and to block up with previously sprayed areas. This would make a total of 73,000 acres that should receive first consideration in the 1952 control plans.

Eastern Oregon Cascades Area

Epidemic infestations of the spruce budworm in this area have been confined to the Mt. Hood National Forest, the Sisters Ranger District of the Deschutes National Forest and the Warm Springs Indian Reservation. These infestations have received priority in control planning because: (1) Budworm populations have been very large and aggressive, (2) the infested areas have increased rapidly in size, and (3) the timber is of relatively high value and is near even more valuable stands west of the Cascade Mountains. A summary of the epidemic infestations and the control operations in the eastern Oregon Cascades is as follows:

<u>Year</u>	<u>Epidemic Acreage Recorded by the Surveys</u>	<u>Total Sprayed Acreage (Infested Acres Plus Buffer Zone)</u>
1948	102,790 acres	
1949	39,990 " 104,460	106,000 acres 40,338
1950	104,460 " 131,888	40,338 " +6,290
1951	77,440 " 160,554	160,554 " 46,628
		166,894

The acreages treated in the eastern Oregon Cascades during the 1951 spraying operations were as follows: Deschutes National Forest 63,069 acres, Warm Springs Indian Reservation 56,515 acres and Mt. Hood National Forest 40,970 acres. Except for one small spray block in the upper portion of Jack Creek on the Deschutes National Forest, where a mortality of only 74.0 percent was recorded, the results of the control work in the eastern Oregon Cascades Area were quite satisfactory. The mortality ranges and average kill on the three units in 1951 were as follows:

<u>Unit</u>	<u>Range of Mortality</u>	<u>Average Mortality</u>
Deschutes	74.0 - 100.0 percent	93.9 percent
Mt. Hood	97.6 - 100.0 "	98.3 "
Warm Springs	100.0 "	100.0 "

Because most of the known centers of epidemic infestation in the eastern Oregon Cascades have been sprayed, the 1951 ground survey was limited to sampling the eastern portion of Mt. Hood National Forest. A total of 35 plots were examined in 3 man days. The budworm was found on 14 plots (40.0%) and was absent on 21 plots (60.0%). The results of the combined aerial and ground surveys in this area will be discussed by control units.

2. Mt. Hood Unit - Two centers of epidemic infestation on the Mt. Hood National Forest were recorded during the 1951 survey. One center of light infestation adjoins the 1951 sprayed area in the Hood River drainage and the other center is in the Beaver Creek drainage and extends into the Warm Springs unit. The 1951 infestation on the

Mt. Hood unit totaled 22,560 acres and was classified as 12,000 acres (53.2%) of light, 8,960 acres (39.7%) of moderate and 1,600 acres (7.1%) of heavy infestation. Practically all of this acreage (97.9%) is in federal ownership. To block up this unit, 14,440 acres of buffer zone should be included in the 1952 control plans. This would make a total of 37,000 acres to be sprayed in 1952 on the Mt. Hood unit.

3. Warm Springs Unit - A total of 34,240 acres of epidemic infestation in three centers (29,440 acres (86.0%) of light infestation and 4,800 acres (14.0%) of moderate infestation) all in Indian or tribal ownership on the Warm Springs Indian Reservation were recorded during the 1951 survey. The northern center, in the Beaver Creek drainage, is a continuation of the Mt. Hood infestation and was part of the 1949 control project that was sprayed too late in the season to effect satisfactory control. Budworm populations have now built back to epidemic proportions and the center should be resprayed. The middle center of infestation in Boulder Creek drainage lies between two control units sprayed in 1951. The southern center of infestation is an extension of a light epidemic infestation on the Deschutes National Forest and is mostly in alpine type timber in Jefferson Creek drainage on the eastern slopes of Mt. Jefferson. Control operations in this latter portion of the unit would not need to be considered for 1952 because of the timber type and elevation. To round out the Beaver Creek and Boulder Creek centers into logical control areas some 5,760 acres of buffer zone should be added to the epidemic areas, making a total of 40,000 acres to be considered in planning 1952 control operations for the Warm Springs Unit.

4. Deschutes Unit - Light epidemic infestations totalling 20,640 acres, all in federal ownership, were recorded on the northern portion of the Deschutes National Forest in 1951. Most of this acreage is in alpine type timber at higher elevations adjoining areas sprayed in 1951. Several scattered centers of light infestation located on Green Ridge have existed for at least two years without increasing in size or without killing any trees. Because of the nature of these infestations and the timber type, control operations are not considered necessary in this unit in 1952. If control operations were undertaken in 1952, it would be desirable to add approximately 16,760 acres of buffer zone making a total of 37,400 acres to treat.

Blue Mountains - Oregon Area

Throughout the course of the present spruce budworm epidemic in Oregon and Washington, the Blue Mountains area of Oregon has consistently harbored the largest acreage of epidemic infestation. The 1951 survey showed that this subregion still contained the principal acreage of budworm infestation in the two states. A record of the development of these infestations and the control operations in this area is as follows:

<u>Year</u>	<u>Epidemic Acreage Recorded by the Survey</u>	<u>Total Sprayed Acreage (Infested Acres Plus Buffer Zone)</u>
1947	665,000 acres	
1948	1,117,000 "	
1949	1,939,000 "	
1950	1,515,080 "	747,781 acres
1951	1,329,480 "	479,164 "

Control operations on the Blue Mountains-Oregon area in 1951 were conducted on the Kinzua Unit 149,578 acres, Ukiah Unit 129,626 acres, Meacham Unit 116,710 acres, Minam Unit 62,903 acres and La Grande Unit 20,347 acres. Experimental spraying operations to test the value of further reduced dosage of DDT were conducted on the latter unit in conjunction with the regular control operations and will be reported on at a later date. The spraying of 118,400 acres of epidemic infestation in the Elgin Unit in 1951 was recommended by the Action Committee but this unit had to be eliminated from the control program because of insufficient federal funds.

The results of the 1951 spraying in the Blue Mountain area were uniformly satisfactory except for a small portion of the Meacham Unit. The mortality ranges and averages for the several units treated in 1951 are as follows:

<u>Unit</u>	<u>Range of Mortality</u>	<u>Average Mortality</u>
La Grande	98.8 - 100 percent	99.5 percent
Minam	98.3 - 100 "	99.5 "
Kinzua	97.1 - 100 "	99.3 "
Ukiah	96.7 - 100 "	99.4 "
Meacham	84.9 - 100 "	97.3 "

With the spruce budworm known to be generally present outside of the already sprayed areas, no systematic ground survey was conducted in the Blue Mountains-Oregon Area in 1951.

The 1951 aerial survey and subsequent ground examinations showed that while there were 1,329,480 acres of epidemic infestation in the Blue Mountains-Oregon area, the intensity of the epidemic was markedly improved over that of 1950. In 1951 there were 893,920 acres (67.2%) of light infestation, 378,640 acres (28.5%) of moderate infestation and 56,920 acres (4.3%) of heavy infestation, of which, 74.1 percent was in federal ownership, 24.5 percent in state, private and other ownership and 1.4 percent in Indian or tribal ownership. In 1950 the acreage of moderate and heavy infestation in this area amounted to 47.2 percent and 9.1 percent respectively. Furthermore, a large percentage of the heavy infestation recorded in 1951 was present on the same areas in 1950 which were not included in the control plan. All in all the budworm situation on the Blue Mountains-Oregon area is very much improved.

The situation in 1951 in this area will be discussed by control units.

5. Ochoco Unit - A total of 85,760 acres of epidemic infestation, 65,120 acres (75.9%) of light and 20,640 acres (24.1%) of moderate infestation, on and adjacent to the Ochoco National Forest, most of which (69.6%) was in federal ownership, were recorded during the 1951 survey. Although this is nearly 22,000 acres more than was recorded on the same unit in 1950, no tree killing by the budworm is imminent. Because of the current status of the outbreak and the fact that infestations on this unit have fluctuated up and down without causing serious damage, control work need not be considered for 1952.

6. Waterman Unit - The 1951 survey revealed a total of 41,000 acres of epidemic infestation (18,000 acres (43.9%) of moderate intensity and 23,000 acres (56.1%) of heavy intensity) on the Waterman Unit, 100 percent of which is in private, state, or other ownership. This unit was to have been included in the 1951 control program; however, early in June these plans were cancelled because of the inability to find adequate budworm populations and because of rather low timber values. While the recent survey showed that 56.1 percent of the 1951 epidemic was classed as heavy infestation, control measures do not appear warranted in 1952 because of the isolated nature of this unit and because a good portion of the more valuable timber has been logged.

7. Malheur Unit - Epidemic infestations totalling 142,400 acres, classified as 117,440 acres (82.4%) light and 24,960 acres (17.6%) moderate, were recorded on and adjacent to the Long Creek and Radio Mountain portions of the Malheur National Forest during the 1951 survey. Federal ownership amounted to 61.9 percent and state, private and other ownership totalled 38.1 percent. While this represents a reduction of 10,000 acres in the over-all infestation recorded in 1950, it is interesting to note that the degree of intensity in 1951 has materially improved over that of 1950. In 1950, 2.8 percent of the total infestation was classified as heavy, 77.9 percent as moderate, and 19.3 percent as light infestation. In 1951 there are no centers of heavy infestation and only 17.6 percent of the area classified as moderate infestation. Because of this generally improved situation, the Malheur Unit need not be considered in control plans for 1952.

8. Susanville Unit - This small unit, less than a township in extent, is part of the Whitman National Forest but would be logically a part of the preceding unit in control planning. A total of 18,880 acres of light epidemic infestation (82.2 percent in federal ownership) was recorded during the 1951 survey. Because of the light intensity of the infestation on this unit and the fact that no tree killing will occur for several years, control operations on this unit need not be considered at this time.

9. Dale Unit - The 1951 survey revealed an area of 23,520 acres of light epidemic infestation in the North Fork John Day River on the

Whitman National Forest. Practically all of the unit (99.3 percent) is in federal ownership. This infestation joins the eastern boundary of the 1950 Ukiah Unit but is not considered serious and need not be included in 1952 control plans.

10. Powder River Unit - Several small scattered areas of light epidemic infestation, totalling only 6,080 acres, in the upper Powder River drainage on the Whitman National Forest are included in this unit. The ownership is 78.9 percent federal and 21.1 percent state, private, or other. Because of the low degree of infestation, no control operations are justified on this unit at this time.

11. La Grande Unit - The 1951 survey recorded an area of 41,120 acres of light epidemic infestation (76.7 percent in federal ownership) largely on the Whitman National Forest and adjoining the Starkey Unit of 1950 and the La Grande Unit of 1951. While there would be some advantage in including this unit in 1952 control plans from the standpoint of blocking up forested areas adjacent to units already treated, the light infestation present at this time and the lack of imminent tree killing would hardly warrant consideration of this unit for 1952.

12. Starkey Unit - A total of 212,640 acres of epidemic infestation on the Umatilla National Forest and located between the Ukiah and Meacham units of 1951 was recorded during the 1951 survey. The Starkey Unit was found to contain 156,960 acres (73.8%) of light and 55,680 acres (26.2%) of moderate infestation. The ownership is 61.4 percent federal, 29.5 percent private, state, or other and 9.1 percent Indian or tribal. This infestation has been present in the Starkey unit for some time and has developed slowly and non-aggressively. The timber type is mixed ponderosa pine, lodgepole pine and fir. Although this unit is situated directly between two large units that were sprayed in 1951 and some advantage would be gained by completing the spraying of the present Starkey Unit to block up this section of the forest, the fact that this is not an aggressive or currently serious epidemic, and being mostly in mixed type, would preclude consideration of the unit for control at this time.

13. Eagle Creek Unit - Two centers of light epidemic infestation totalling 24,960 acres (93.6 percent in federal ownership) in the upper Catherine Creek and Eagle Creek drainages on the Whitman National Forest were recorded during the 1951 survey. Control measures would not be warranted on this unit in 1952 because of the nature of the present epidemic and the fact that much of the affected timber is sub-alpine type which is of low value and, furthermore, is believed to be relatively resistant to the effects of the budworm.

14. Minam Unit - The Minam Unit, which is an expansion of the same unit sprayed in 1951, was found to harbor 70,880 acres of epidemic infestation, of which, 25,600 acres (36.1%) were heavy, 38,880 acres (54.9%) were moderate and 6,400 acres (9.0%) were light. The ownership is 85.8 percent federal and 14.2 percent private, state, or other.

This epidemic is largely in the drainages of Minam River, Trout Creek, Big Canyon Creek and Bear Creek and is on the Wallowa and Whitman National Forests. The timber type is mixed fir and ponderosa pine of good quality in the canyon bottoms but of only fair quality on other portions of the unit. The present area of infestation was eliminated from the 1951 control plans in the hope that natural control factors would take effect before spraying operations would be needed. However, the intensity of the infestation has increased and with 91 percent of the unit classed as heavy and moderately heavy infestation, direct control operations should be undertaken in 1952.

15. Joseph Unit - A light epidemic infestation of 106,240 acres, of which, 84.7 percent is in federal ownership, on the Wallowa National Forest in the drainages of Little Sheep Creek, Sheep Creek, Grouse Creek and the Imnaha River was located during the 1951 survey. This light infestation has been present in the same general area for several years without increasing in severity; however the area has increased in size from that reported in 1950. Since this is an apparently nonaggressive infestation in timber types of generally low value, no control measures need be considered for some time.

16. Snake Unit - Some 183,040 acres of epidemic infestation, of which 133,120 acres (72.7%) are light and 49,920 acres (27.3%) are moderate on the Wallowa National Forest, mostly in the Snake River drainage, were recorded on the 1951 survey. Practically all of the ownership (96.2 percent) is federal. Like the infestation on the Joseph Unit, the epidemic on the Snake Unit has been present for several years in stands of very low quality without increasing in severity or without killing any timber. While the 1951 survey showed that the several scattered areas of infestation present in 1950 coalesced in 1951 to form one continuous belt of infestation, this situation is not considered serious. No control plans need to be made for this unit for 1952 or for some time to come.

17. Chesnimnus Unit - An area of epidemic infestation totalling 86,560 acres in the northeastern portion of the Wallowa National Forest was recorded in the 1951 survey. This infestation was classified as: 50,560 acres (58.4%) light, 27,680 acres (32.0%) moderate, and 8,320 acres (9.6%) heavy and was 96.5 percent in federal ownership. Because the budworm has been present in the same general area for several years without causing any appreciable loss of timber, it is felt that control measures will not be necessary in 1952.

18. Day Ridge Unit - In reality, the Day Ridge Unit is a part of the Elgin Unit, however, it is being considered as a separate unit for purposes of control planning. The 1951 epidemic infestation on the Day Ridge Unit totals 31,840 acres, of which, 24,640 acres (77.4%) are light and 7,200 acres (22.6%) moderate infestation. Federal ownership in this unit equals 68.3 percent of the total area and state, private or other ownership accounts for the balance of 31.7 percent. With most of the

infestation in this unit classified as "light" and with no tree killing anticipated for at least two years, control in 1952 would be warranted only for purposes of blocking out the Elgin Unit.

19. Elgin Unit - The Elgin Unit, most of which is within or adjacent to the Umatilla National Forest, contains more acres of spruce budworm epidemic infestation than any other unit recorded during the 1951 survey. A total of 215,520 acres are included in the unit, of which 82,720 acres (38.4%) are of light intensity and 132,800 acres (61.6%) are of moderate intensity. Ownership in this unit is 65.5 percent federal and 34.5 percent state, private and other. This unit is bounded on the north by the Wenaha River and on the west and south by the boundaries of the North Umatilla Control unit of 1950. The control of the budworm menace on the Elgin Unit was recommended and approved for the 1951 project but these plans were cancelled because of insufficient federal funds. Timber values are high in this unit. Control in 1952 would go far toward completing control coverage in the commercially important stands of the northern portion of the Umatilla National Forest and adjoining areas.

20. Wenaha Unit - The Wenaha Unit is continuous with the Saddle Mountain Unit in the State of Washington. They are divided for administrative reasons. The Wenaha Unit is separated from the Elgin Unit by the sharp breaks of the Wenaha River canyon. A total of 39,040 acres of epidemic infestation - 36,160 acres (92.6%) light and 2,880 acres (7.4%) moderate - are included in this unit. Ownership is 88.5 percent federal and 11.5 percent state, private and other. While timber values in this unit are fairly high, the infestation has been present for several years without causing tree mortality and it is felt that control measures are not needed in this unit in 1952.

Blue Mountains - Washington Area

Spruce budworm epidemic infestations of increasing intensities have been recorded in the Blue Mountains Area of Washington during each survey since 1947. While the fir forests of this area are primarily important from a watershed protection standpoint, they are becoming of increasing value as a source of lumber supply and the menace of the budworm has caused real concern to owners and managers of timberlands throughout the area. The extent of the infestations and the control work undertaken in this area is as follows:

<u>Year</u>	<u>Epidemic Acreage Recorded by the Surveys</u>	<u>Total Sprayed Acreage (Infested Acres Plus Buffer Zone)</u>
1947	45,000 acres	
1948	126,000 "	
1949	165,000 "	
1950	295,000 "	25,853 acres
1951	182,880 "	115,672 "

During the 1951 control operation, a total of 115,672 acres of heavy epidemic infestation were sprayed in the Blue Mountain Area of Washington. The mortality of the budworm was excellent and was found to range from 95.7 to 100 percent with an average of 99.1 percent.

The 1951 regional survey revealed a total of 182,880 acres of epidemic infestation in the area, of which, 53,600 acres (29.3%) are light, 106,080 acres (58.0%) are moderate and 23,200 acres (12.7%) are heavy. The ownership is 79.0 percent federal and 21.0 percent state, private and other. No organized ground sampling survey was conducted in this area in 1951 because the budworm can be found throughout the area.

The budworm situation in the Blue Mountains-Washington area in 1951 will be discussed by three control units.

21. Saddle Mountain Unit - The spruce budworm infestation on the Saddle Mountain Unit is an extension of the infestation on the Wenaha Unit in Oregon and is mostly within the Umatilla National Forest. A total of 52,320 acres of epidemic infestation were shown by the 1951 survey. Areas of light infestation totalled 31,040 acres (59.3%) and areas of moderate infestation totalled 21,280 acres (40.7%). The ownership is 85.6 percent federal and 14.4 percent state, private and other. Most of the current epidemic is of light intensity and a high percentage of the moderate infestation is found in stringers of timber of little commercial value. Because of these facts, control measures in 1952 are not deemed essential.

22. Touchet Unit - A Total of 35,360 acres of epidemic infestation, classified as 10,720 acres (30.3%) light and 24,640 acres (69.7%) moderate were recorded during the 1951 survey in the Touchet Unit. The ownership is 86.4 percent federal and 13.6 percent other. As shown on the 1951 infestation map, the present unit lies between two larger units sprayed in 1951. The need for blocking up the treated areas in this portion of the Blue Mountains, combined with the degree of infestation and the value of the affected timber on the Touchet Unit, make it highly desirable to treat this unit in 1952.

23. Anatone Unit - The 1951 survey recorded a total of 95,200 acres of epidemic infestation in the Anatone Unit in the northeastern portion of the Umatilla National Forest. This is the largest unit of infestation in the area and was classified as 11,840 acres (12.4%) light, 60,160 acres (63.2%) moderate and 23,200 acres (24.4%) heavy, with the ownership 72.6 percent federal and 27.4 percent state, private and other. Because the timber values in most of this unit are fairly high and because 87.6 percent of the infestation is of a serious nature, control measures should certainly be undertaken in this unit in 1952.

Treatment of the Anatone, Touchet, and Elgin Units should for all practical purposes complete the control program on the North Umatilla portion of the Blue Mountains area.

Eastern Washington Cascades Area

The spruce budworm has been recorded in outbreak proportions in the eastern Washington Cascades area several times since 1943. An epidemic on the Chelan National Forest lasted from 1943 to 1948 without causing any appreciable loss of timber. The first budworm infestation of any consequence in the eastern Washington Cascades developed rather suddenly in 1950 in the Icicle Creek drainage of the Wenatchee National Forest. This was a very aggressive outbreak and large populations of the budworm were evident throughout the drainage. Because of the severity of the attacks and the timber and recreational values involved, control measures were instituted in 1951. A summary of the extent of the infestations and the control work in the eastern Washington Cascades is as follows:

<u>Year</u>	<u>Epidemic Acreage Recorded by the Surveys</u>	<u>Total Sprayed Acreage (Infested Acres Plus Buffer Zone)</u>
1947	197,600 Acres	
1948	(No Survey)	
1949	(Surveyed-No Infestation)	
1950	25,440 Acres	
1951	3,840 "	9,420 acres

The 1951 control work was administered by the Washington Division of Forestry. A total of 9,420 acres of infestation was sprayed in what proved to be the most difficult area of the 1951 project. The infestation was in the narrow, steep-walled canyon of Icicle Creek where down drafts and turbulent air conditions made spraying most difficult. As a result a less satisfactory kill than that obtained in other units was found on the Wenatchee Unit in 1951. While several mortality checks were to have been made following spraying in this unit, only one count of 85 percent mortality was obtained. It is felt, however, that the average kill in this unit was heavier than that shown by the one count.

During the 1951 ground survey, 301 sample plots were examined in the eastern Washington Cascades area in a total of 35 man days. The budworm was found to be present on only 20 plots (6.6%) and absent on 281 plots (93.4%). The only potentially serious center of epidemic infestation recorded in 1951 was on the Wenatchee Unit.

24. Wenatchee Unit - The 1951 survey recorded a total of 3,840 acres of light epidemic infestation in federal ownership which was mostly in the Jack Creek drainage of the Icicle Creek canyon on the Wenatchee National Forest. It is probable that this infestation was present in 1950 but in lighter concentrations not readily visible from the air. Because of the technical difficulties encountered in spraying infestations of this character and the present light degree of defoliation it is deemed advisable to omit this small infestation from any 1952 control plans. The unit will be closely watched and if in the future control measures are warranted they will be recommended.

Discussion and Recommendations

The time has come when the spruce budworm situation in Oregon and Washington should be carefully reviewed and decisions made as to the control strategy for the concluding phases of the control program. During the aerial spraying operations of 1949, 1950, and 1951 a total of 2,130,865 acres of epidemic infestations have been brought under control. This tremendous accomplishment has been the result of whole-hearted cooperative effort, efficient management, adequate financial backing by private and public agencies, and a proven economical method of control.

Graph 1, Map 2 and a digest of the survey findings of 1951 clearly indicate that the control program has had a marked effect in reducing the areas of epidemic budworm infestation and in preventing wholesale killing of valuable forest resources. Although 1,650,600 acres of epidemic budworm infestation still remain in Oregon and Washington, the situation is generally favorable. On most units the trees can withstand from two to three years of additional defoliation. Control planning now is somewhat of a gamble on how long the epidemic will run.

Direct control measures through the aerial application of DDT were originally undertaken in the areas of heaviest epidemic infestation in both Oregon and Washington where tree killing was imminent in an attempt to prevent destruction of our valuable timber resources. Such measures were advocated only until natural control agencies could effect control of the budworm menace. Although there is as yet no evidence of a general break in the budworm epidemic, there were local indications, both in 1950 and 1951, that natural control may take over in the reasonably near future. Unfortunately, no assurance can be given on this point.

A total of 610,920 acres of moderate and heavy epidemic infestations were recorded during the 1951 survey. The remainder of the infestation (1,039,680 acres) is classified as light, with no tree mortality imminent for several years. In view of the outstanding success of the control program to date, the uncertainty as to the course of the epidemic in the immediate future and also to prevent any possible loss of ground through reinfestation of treated areas, the following recommendations are offered for 1952:

1. As many as possible of the 610,920 acres of moderate and heavy epidemic infestation reported in 1951 should be treated.
2. First priority should be given to the centers of infestation in western Oregon and the eastern Oregon Cascades.
3. Second priority should be given to the centers of heavy infestation in the Blue Mountains area of Oregon and Washington where timber and watershed values are high enough to warrant control operations.

4. Third priority should be given to the blocking up of unsprayed units of lighter infestation adjacent to previously treated units to prevent any possible reinestation and the loss of ground already gained.

PART II - OTHER MAJOR FOREST INSECT PROBLEMS

During the course of the 1951 cooperative survey, as in all previous surveys, data were secured on the epidemic infestations of numerous species of forest insects as well as losses from other factors. In this report only those outbreaks of major forest insect pests, against which control programs might possibly be instituted, will be considered. A follow-up report is planned in which the activities of the other species of insects will be discussed.

Mountain Pine Beetle

As reported in 1950, an aggressive epidemic of the mountain pine beetle in lodgepole pine in the Wanoga Butte area on the Bend Ranger District of the Deschutes National Forest has been in progress for several years. This epidemic has been confined to about 20,000 acres but poses a real threat to the extensive stands of lodgepole pine in other portions of Deschutes County and in Klamath and Lake Counties.

During October 1951, another 10 percent survey was made in the heaviest infested portions of the Wanoga Butte area and a $2\frac{1}{2}$ percent survey was made in the remaining portions of the Wanoga Butte area. In addition, a $2\frac{1}{2}$ percent survey was made through some 17 sections of lodgepole pine south of Wanoga Butte, where scattered red-topped lodgepole pines were mapped in place during the 1951 aerial survey. The ground checking south of Wanoga Butte was to determine if the mountain pine beetle epidemic had begun to move southward toward Pistol Butte and into other stands of mature lodgepole pine.

The estimated number of 1951 infested trees in the Wanoga Butte area was computed to be $38,000 \pm 3,000$ trees. No significant concentrations of mountain pine beetles were found in the Pistol Butte area.

In spite of a salvage program undertaken by the Forest Service, during which nearly 4,100 infested trees containing overwintering larvae and adult beetles were to be removed from the area in 1951, and some winter killing during the winter of 1950-1951, this epidemic continued to be aggressive in 1951. However, there is evidence that this virulent outbreak is beginning to break up. Large areas of so-called "burnt out stands," which would no longer support a mountain pine beetle epidemic, are now evident and the 1951-1952 attacks appeared to be concentrated in approximately 9 sections near the middle of the Wanoga Butte area. The big problem now is whether the outbreak will spread to other areas.

Favorable terrain and good access roads make the Wanoga Butte area readily available for logging. Salvage operations of both the dead timber and the larger green trees should be encouraged as a means of halting the epidemic without the expenditure of funds for direct control.

While this insect continues to be locally epidemic in stands of lodgepole pine and white pine in many other spots in the Oregon and Washington Cascades and in non-commercial lodgepole stands and second growth stands of ponderosa pine in the Blue Mountains, the Deschutes epidemic is of most concern. All told, 147 centers of mountain pine beetle epidemics covering 260,000 acres were recorded in the two states during the 1951 survey. No direct control measures appear warranted in these areas, other than in Crater Lake and Mount Rainier National Parks where a small amount of maintenance control work is desirable to protect recreational values.

Western Pine Beetle

For the first time since 1941, group killing of ponderosa pine by the western pine beetle was evident in many forests. The 1951 survey revealed that rather serious losses of ponderosa pine--mostly on the better sites--were occurring principally on the Warm Springs Indian Reservation, the Chewaucan Area of the Fremont National Forest, areas on the Malheur National Forest previously cut by a 40% Economic Selection system of marking, and on portions of the Deschutes National Forest. A total of 65 centers of epidemic infestation covering 303,000 acres has been reported by the 1951 survey.

Reports from foresters throughout the ponderosa pine region of Oregon and Washington indicated that this flare-up of the western pine beetle was rather general throughout the region. Where possible, salvage operations should be started to remove the infested groups of trees while they are still merchantable and to prevent the spread of adult beetles during 1952. No direct control is necessary at present.

Douglas Fir Beetle

Severe windstorms during the winter of 1949-1950 uprooted or damaged extensive areas of Douglas fir in both Oregon and Washington. As expected, the Douglas fir beetle attacked the windthrown and broken trees and large populations of this beetle were built up. During 1951 a tremendous volume of green standing timber was attacked by the beetles emerging from the wind-damaged trees. The 1951 survey reported a total of 106 centers of Douglas fir beetle attack which covered some 168,000 acres. The heaviest centers of infestation were found on the Umpqua, Siuslaw, Willamette, and Gifford Pinchot National Forests and in the vicinity of Coos Bay, Oregon. The tremendous losses caused by the wind and subsequent beetle outbreak impose a salvage problem that well may continue to expand for several years due to the now epidemic beetle population and the large volume of drought-weakened and fire-killed timber present in the region after the past season. Salvage of the windthrown trees, as well as the weakened, red-topped, and freshly-attacked trees, should be undertaken at once both to keep the outbreak from spreading and to utilize the dead timber.

Fir Engraver Beetles

In recent years, extensive damage to stands of silver fir in north-western Washington has been caused by species of fir engraver beetles. Each year's survey has reported an increase in this type of damage. The 1951 survey reported a total of 129 centers of infestation totalling nearly 243,000 acres. This type of damage was found throughout the Washington and Oregon Cascades as well as on the Olympic Peninsula. Salvage operations in the areas of infestation to prevent the spread of the beetles to other areas is about all that can be recommended at this time.

Hemlock Looper

Because of the destructive potential of the hemlock looper, any outbreak of this pest is serious. Several small areas of infestation of the hemlock looper totalling 400 acres were recorded in Clallam County, Washington in 1949. Some 5,000 acres were found to be infested in 1950 and a small amount of timber had been killed. A resurvey in 1951 recorded 27 centers of infestation totalling 4,640 acres, confined largely to the same general areas observed in 1950. Tree killing as a result of this defoliation is still very limited and the looper population seems to have decreased markedly. Control measures are not deemed necessary; however, this area is being kept under close observation and action will be taken if the outbreak becomes aggressive.

PART III - APPENDIX

Acknowledgments

The 1951 forest insect survey in Oregon and Washington was conducted through the cooperative efforts of many individuals and organizations. A list of the numerous individuals and agencies having a part in the detailed spruce budworm ground survey project of 1951 is given in Tables 6-9 and a summary of this participation is given in Table 4. Many observers, organized through the efforts of the Western Pine Association, reported upon the forest insect conditions in the ponderosa pine region of the two states. These observers and their findings will be recorded in a later report.

The Bureau of Entomology and Plant Quarantine and the Oregon State Board of Forestry assumed the lead in conducting and coordinating the survey program and reporting the results. The Washington State Division of Forestry contributed many man days to the gathering of survey data. The U. S. Forest Service aided materially both in the field and in processing this report. Messrs. J. M. Whiteside and A. Lindsten headed the program for the Bureau and the State of Oregon respectively. Active participation on the part of many foresters representing industry was secured through the efforts of Mr. W. D. Hagenstein, forest engineer of the Forest Conservation Committee of Pacific Northwest Forest Industries and Mr. E. L. Kolbe, chief forester of the Western Pine Association.

The aerial phase of the 1951 survey (Table 3) was a cooperative undertaking between the Oregon State Board of Forestry, the Bureau of Entomology, and the U. S. Forest Service. The State surveyed all of western Oregon. The Bureau surveyed all of eastern Oregon and all of Washington. After the unfortunate accident, which wrecked the Bureau's Cessna 195, the Forest Service financed the rental of a Cessna 170 to complete the Bureau's portion of the aerial survey. For the State, Mr. A. Larson was pilot and Messrs. A. Lindsten, R. Stevens, and W. Slater were observers and mappers. For the Bureau, Mr. J. F. Wear was pilot and Messrs. W. J. Buckhorn, H. L. Haglund, W. K. Coulter were observers and mappers.

The ground checking of the aerial survey findings was done primarily by Messrs. W. J. Buckhorn, H. L. Haglund, W. K. Coulter, and K. H. Wright for the Bureau; A. Lindsten, R. Stevens and W. Slater for the State. Mr. D. C. Prentice of the Western Pine Association assisted with the ground checking in the Deschutes and Klamath Basins and in the mountain pine beetle survey on the Wanoga Butte area. Messrs. E. Clark and G. George of the Deschutes National Forest also assisted with the Wanoga Butte survey.

LIST OF REPORTS AND PUBLICATIONS

Brockman, C. F. War on the Budworm. American Forests 56(9): 22-3, 43-5, illus. 1950.

Brockman, C. F. and D. Berry. The Chesnimum Experimental Spruce Budworm Control Project. Oregon State Board of Forestry Research Bulletin No. 5. December 31, 1950.

Buckhorn, W. J. Defoliator Situation in the Fir Stands of Eastern Oregon and Washington, Season of 1947. Forest Insect Laboratory Report, February 18, 1948.

Eaton, C. B., J. A. Beal, R. L. Furniss, and C. F. Speers. Airplane and Helicopter Spraying with DDT for Spruce Budworm Control. Journal of Forestry 47 (10): 823-7. 1949.

Furniss, R. L., W. J. Buckhorn and K. H. Wright. The Spruce Budworm in Oregon and Washington, Season of 1948. Forest Insect Laboratory Report, November 1, 1948.

Lindsten, A., W. J. Buckhorn, J. F. Wear, J. M. Whiteside, and K. H. Wright. Spruce Budworm Situation in Oregon and Washington, Season of 1949. Mimeographed Report, September 1, 1949.

Lindsten, A. and K. H. Wright. Report on the 1949 Western Oregon Spruce Budworm Control Project. Multilithed Report, March 30, 1951.

Olson, H. Fighting the Spruce Budworm by Air Attack. Nature Magazine 44 (4): 182-4, 194, illus. 1949.

Oregon State Board of Forestry and Bureau of Entomology and Plant Quarantine. Report of Forest Insect Detection Surveys in Oregon and Washington, Season of 1950. Multilithed Report, September 30, 1950.

Oregon State Board of Forestry. 1950 Spruce Budworm Control Project. Mimeographed Report, March 1951.

Spruce Budworm Action Committee. Plan for Control of the Spruce Budworm in Oregon - 1949. Mimeographed Report, November 12, 1948.

Spruce Budworm Action Committee. Spruce Budworm Control Plan for 1950 in Oregon and Washington. Multilithed Report, October 1, 1949.

Spruce Budworm Action Committee. Spruce Budworm Control Plan for 1951 in Oregon and Washington. Multilithed Report, October 27, 1950.